

Development of Visco-elastic Composite Panels for Increasing Damping in Hospital Buildings

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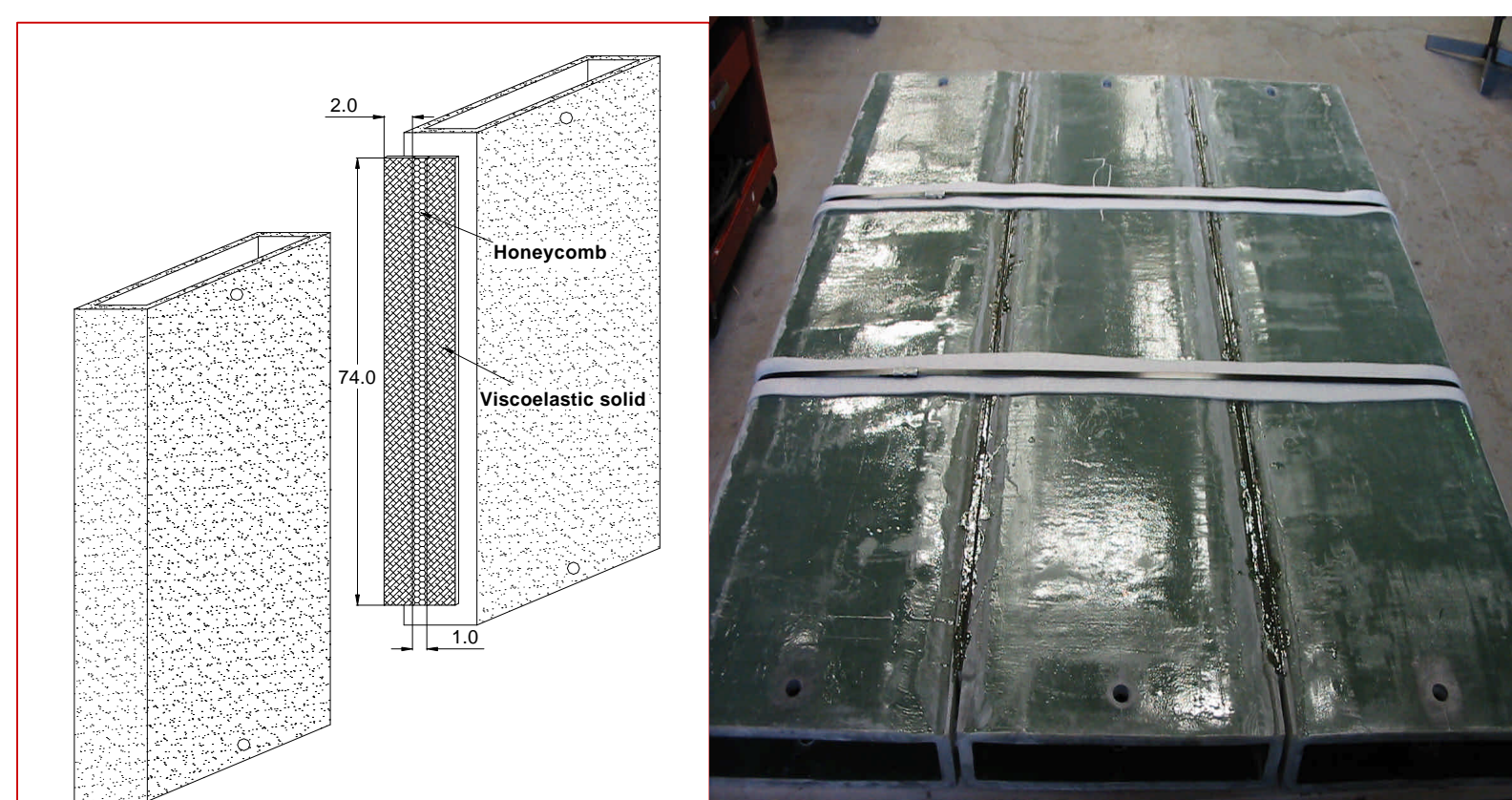


ABSTRACT

In this research viscoelastic composite panels used for increasing structure's damping are developed. The damping effective of Fiber Reinforced Polymer (FRP) infill wall system for structure retrofitting was investigated. By comparing the analytical solution with numerical simulation, a damping modification coefficient is proposed. The damping modification coefficient is a function of the excitation frequency which is independent of the FRP infill wall's geometry configuration and inclination. Using the damping modification coefficient the FRP infill wall system can be calculated and used easily in numerical simulation. The seismic analysis of the hospital building with added FRP infill wall system shows that the simplified model works well and significant increasing of the structure damping is gained.

BACKGROUND

Earthquake-resistant design and retrofitting of structures using various energy absorption devices such as viscoelastic (VE) dampers, viscous fluid dampers, friction dampers, and added damping and stiffness devices have received considerable attention in recent years. Similar to partial rehabilitation techniques using composite material such as column wrapping, the use of prefabricated polymer matrix composite (PMC) infill panel systems is a very efficient way to achieve seismic retrofitting of existing facilities because of the efficiency of the material and its ease of use in construction.

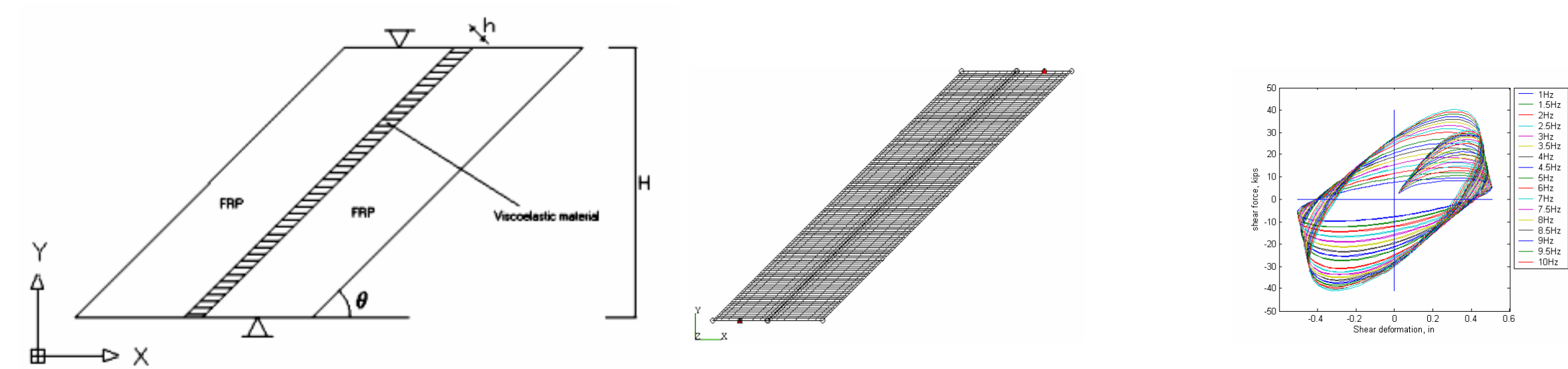


OBJECTIVES

1. Study the effective use of Fiber Reinforced Polymer (FRP) Infill panels for passive seismic energy dissipation
2. Introduce energy dissipation effects produced by novel combined interface damping layers along with the investigation of several design parameters
3. Devise analysis and design procedures for FRP infill frames.
4. Characterize the properties of advanced composite panels and their impact on modifying the response of hospital structures.
5. Find optimal layout of the FRP interface layer and the geometry shape of the infill wall system

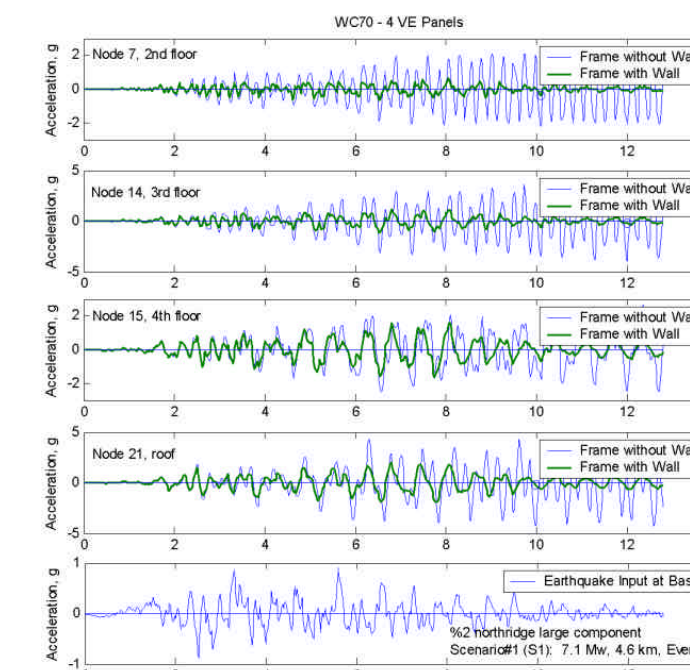
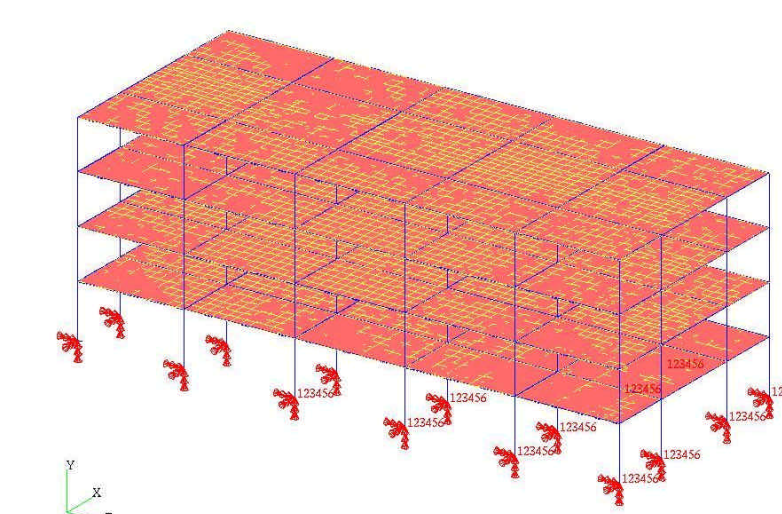
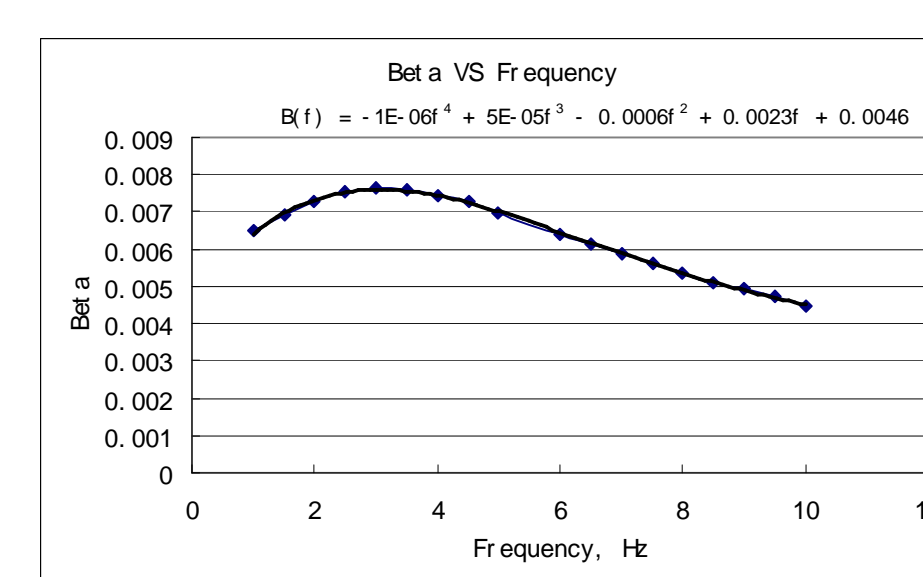
METHODS

Based on viscoelastic theory and passive energy dissipation method, a simplified damper model was proposed and analytical solution was found for the FRP infill wall system. An optimal FRP panel inclination was investigated based on the simplified model. The analytical solution was compared with numerical results and a damping modification coefficient was proposed. The properties of the damping modification coefficient were investigated. Using the damping modification coefficient, the FRP infill wall system's damping coefficient was calculated easily and a simplified damper model was modeled in ABAQUS in stand of the complicated FRP infill wall system. The MCEER demonstration hospital building with added FRP infill wall system was analyzed under ground motion.



RESULTS

- Optimal FRP infill wall panels inclination was found.
- Simplified equivalent damping coefficient of the FRP infill wall was found with a modification coefficient β .
- The modification coefficient β is independent of the FRP infill wall's inclination.
- The modification coefficient is independent of the FRP infill wall's geometry configuration.



Peak Acceleration Response for Earthquake S#1, g			
	With Wall	Without Wall	Reduction
roof	1.958	4.3648	55%
4th floor	1.6135	2.6431	39%
3rd floor	1.1685	4.0271	71%
2nd floor	0.645	2.1865	71%
Base	0.9054	0.9054	0.00%

CONCLUSIONS

- The FRP infill wall system can dissipate most of the energy inputted to the structure system and increase the structure's damping significantly.
- Based on the analytical modeling of the FRP infill wall optimization of design parameters with respect to the inclination of wall, the fiber orientation and laminate thicknesses have been performed and verified by numerical analysis.

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